

**tallized and textured using a repetitive sequence of
incremental reaction
and mechanical swaging steps. During the formation of
metal-ceramic composites
that comprise a ceramic member possessing a thermal
reaction temperature in
excess of the melting temperature of the metal member
to which it is bonded, it
is preferred to utilize electromagnetic radiation to react
and crystallize the
ceramic member. In this embodiment a beam of
electromagnetic radiation,
characterized by an electromagnetic energy that is
either in the microwave
frequency spectrum or in the infrared frequency
spectrum, can be directed onto
the ceramic member to advance its state of
crystallization. Simultaneously,
the metal member, which is not irradiated by a suitably
directed
electromagnetic beam, can be held to a temperature
well below its melting
point. It is now well known to practitioners skilled in
the art of microwave
annealing of ceramic and other materials, that certain
frequencies**

cting, or magneto-sensitive
pr perties.

An optional step "F" is used in which the amorphous oxide coating 17 of article 15 is thermally reacted, or reacted by exposure to electromagnetic radiation at frequencies in the microwave or optical spectrum, in a controlled gas atmosphere to form an article 19 that comprises a fully or partially crystallized randomly oriented ceramic layer 21 on a substrate 9. Any such processing treatment that advances the state of crystallinity in the ceramic layer is herein referred to as a "reaction step". Reaction steps involve the delivery of heat to the ceramic of an amount sufficient to activate solid-state diffusion mechanisms and crystalline ordering in the ceramic, which may comprise thermal heat treatments wherein the ceramic is exposed to an elevated temperature, or radiation treatments wherein heat is delivered to the ceramic through the absorption of electromagnetic radiation. Heat must be delivered to the ceramic in an amount equivalent to the amount of heat contained within the ceramic at a crystallization temperature. Crystallization temperature s f r